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REVIEW ARTICLE

Gynecology

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# Systematic review of same-day discharge after minimally invasive hysterectomy

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## Abstract

**Background:** Same-day discharge has been suggested to safe and acceptable following minimally invasive hysterectomy.

**Objectives:** To evaluate the feasibility of same-day discharge following minimally invasive hysterectomy and to identify associated factors.

**Search strategy:** Medline, Embase and the Cochrane Central Register of Controlled Trials were systematically searched using the terms “same day discharge”, “minimally invasive surgery”, and “hysterectomy” between October 1 and October 31, 2015. No language or publication date restrictions were included.

**Selection criteria:** Randomized controlled trials and observational studies evaluating same-day discharge before midnight on the day of minimally invasive hysterectomy were included.

**Data collection and analysis:** Study characteristics, pre-operative selection criteria, and predictive factors for same-day discharge were analyzed.

**Main results:** There were 15 observational studies with 11 992 patients included. Significant heterogeneity was observed in the studies, and publication and selection bias could have potentially affected the results. All the studies concluded that same-day discharge was feasible. However, some factors were associated with a decreased possibility of same-day discharge; these were older age, beginning surgery later than 1:00 PM and completing surgery later than 6:00 PM, longer duration of operation, and high estimated blood loss.

**Conclusions:** Same-day discharge appears feasible for a majority of patients who undergo minimally invasive hysterectomies if adequate emphasis is placed on pre-surgical planning and careful patient selection.

## KEYWORDS

Gynecologic oncology; Hysterectomy; Laparoscopic; Minimally invasive; Review; Robotic surgery; Same-day discharge

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## 1 | INTRODUCTION

Hysterectomy is one of the commonest gynecologic surgical procedures and an increasing number of hysterectomies are being completed minimally invasively.<sup>1–3</sup> Laparoscopic supra-cervical hysterectomy, laparoscopically assisted vaginal hysterectomy, total laparoscopic hysterectomy, and robotic-assisted laparoscopic hysterectomy are common minimally invasive techniques in gynecologic surgery.<sup>4–6</sup> Minimally invasive surgery has been adopted widely within gynecologic oncology and is increasingly used in advanced surgical staging procedures for both endometrial and cervical cancer.<sup>7–9</sup> Compared with open surgery, minimally invasive surgery offers fewer complications, faster recovery, a reduction in the duration of hospital stay, earlier return to activities, reduced pain and estimated blood loss, smaller incisions, and improved cosmetic outcomes.<sup>4,10–13</sup>

Previously, hysterectomies have been performed as in-patient operative procedures to manage post-operative pain and monitor post-operative complications such as symptomatic anemia or delayed return of bowel function.<sup>14</sup> Studies have described same-day discharge after laparoscopic hysterectomy to be safe and acceptable,<sup>15–19</sup> and same-day discharge can reduce hospital costs and decrease iatrogenic complications associated with hospitalization such as venous thromboembolic complications due to delayed mobilization or infections.<sup>20</sup>

The aim of the present systematic review was to evaluate if same-day discharge is feasible after minimally invasive hysterectomy and to identify factors associated with same-day discharge.

## 2 | MATERIALS AND METHODS

The present systematic review protocol was registered in the international prospective register of systematic reviews (PROSPERO/ID CRD42014013453) on September 8, 2014. The review was conducted in accordance with the PRISMA statement and checklist,<sup>21</sup> which are relevant when reporting systematic reviews of non-randomized studies to assess the benefit and harms of interventions.

Medline, Embase, and the Cochrane Central Register of Controlled Trials were searched on October 4, 2015 by an investigator (M.K.) with the assistance of an experienced librarian. Inconsistencies in the identification of potentially relevant papers were discussed by four authors (M.K., M.M.J., V.K.L., and P.T.J.) until consensus was reached. No language or publication-date restrictions were applied. The Journal of Robotic Surgery is only partly indexed on Medline (from 2007 onwards) and was screened manually for relevant studies on October 16, 2015 by an investigator (M.K.). The reference lists from relevant articles were also searched. The database searches used medical subject headings (MeSH) terms and a keyword search with Boolean operators ("OR" and "AND"). The combined search terms included "Patient Discharge OR same day discharge", "Surgical Procedures OR minimally invasive surgery", and "Hysterectomy OR gynecologic cancer". Non-full-text manuscripts were excluded and all articles were identified by title. All titles and abstracts were downloaded and managed using EndNote X7 (Thomson Reuters, New York, NY, USA), and duplicates were removed.

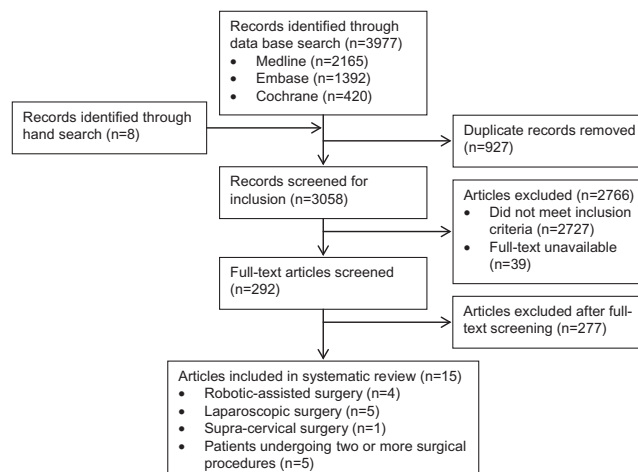
Studies were included if the populations included patients who underwent minimally invasive hysterectomy for benign or malignant indications. The minimally invasive techniques included in the review were total laparoscopic hysterectomy with or without bilateral salpingo-oophorectomy, sentinel-node mapping, pelvic and/or para-aortic nodal dissection, appendectomy, and omentectomy. The review included peer-reviewed studies where hysterectomies were performed minimally invasively and patients were discharged on the day of surgery before midnight. Studies not including discharge details and studies including only vaginal hysterectomies were excluded (Fig. 1). Only studies performed within gynecology departments were included because the aim of the study was to compare institutions that were experienced in performing minimally invasive hysterectomies.

In the absence of a suitable checklist for recording bias in observational studies, a checklist was designed that was inspired by evidence-based clinical practice guidelines developed by the Scottish Intercollegiate Guidelines Network for use in the National Health Service in Scotland.<sup>22</sup> In the checklist, the intervention was minimally invasive surgery, and the outcome was categorized as hospitalization or same-day discharge (Fig. 2). To determine the risk of bias, two authors (M.K. and M.M.J.) made an overall assessment of studies, as well as independently assessing the validity of patient selection, and the descriptions of the study populations, surgical circumstances, outcome variables, confounding variables, and statistical analyses. Any disagreements were resolved by consensus.

The primary outcome of the present study was the possibility of same-day discharge before midnight and the secondary outcome was the factors associated with same-day discharge. The highest available level of evidence was included<sup>23</sup> and descriptive statistics were used to describe the studies.

## 3 | RESULTS

The initial search returned 3985 citations, with 3058 remaining following the elimination of duplicates (Fig. 1). Following the screening



**FIGURE 1** Flow diagram of study selection.



### Selection of study sample

Consecutively collected



Losses or exclusion described

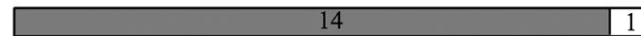


### Description of the study sample

Age



BMI



American Society of Anesthesiologists (ASA)



Diagnoses



Surgical history



Comorbidity



### Surgical circumstances

Type of surgery



Level skill of the surgeon



### Outcome variables

Adverse events collected systematically



Outcome clearly defined



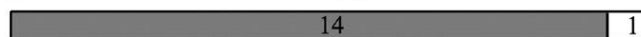
Conversion to laparotomy



Length of stay



Postoperative complications



Readmission (number)

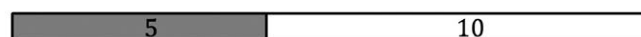


### Counding

Potential confounders are identified and taken into account in the design



Potential bias are identified taken into account in the design and analysis



### Statistical analysis

Have confidence intervals been provided

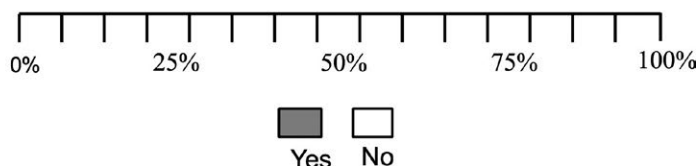
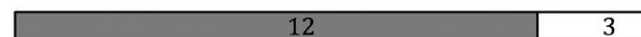


### Overall assessment of the study

Minimizing the risk of bias or confounding:  
High quality X acceptable V Unacceptable 0



Taking into account clinical considerations, the evaluation of methodology used and the statistical power of the study, are there clear evidence of an association between the intervention and the result in observational studies



**FIGURE 2** Assessment of risk of bias in observational studies. Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists score.

**TABLE 1** Characteristics and participants from included studies.

Study	Country	Design	No. of patients	Surgical indication	Age, y	BMI/weight	Surgical techniques applied	Operative time, min	EBL, mL	Same-day discharge	Length of hospital admission	Readmission
Penner et al. <sup>8</sup>	USA	Retrospective	141	141 M	60 <sup>b</sup>	BMI 26 <sup>d</sup>	TLH, RALH±BSO bilateral pelvic and para-aortic lymphadenectomy	146 <sup>bd</sup>	50 <sup>bd</sup>	118 (83.7%)	225 min <sup>d</sup>	17 (12.1%) within 6 wk
Borahay et al. <sup>10</sup>	USA	Retrospective	16	16 B	43.1	BMI 33.8 <sup>c</sup>	RALH	217.4 <sup>bc</sup>	33.6 <sup>bc</sup>	14 (87.5%)	1.13 d <sup>c</sup>	1 (7.1%) (time interval not specified) <sup>b</sup>
Rivard et al. <sup>14</sup>	USA	Retrospective	140	45 B, 95 M	56.7	BMI 34.0 <sup>c</sup>	RALH±BSO, pelvic and para-aortic lymphadenectomy, ±omentectomy, ±appendectomy, debulking	NA	100	90 (64.3%)	5.3 h <sup>d</sup>	2 (2.2%) within 30 d <sup>b</sup>
Perron-Burdick et al. <sup>16</sup>	USA	Retrospective	1015	1015 B	45 <sup>b</sup>	BMI 28 <sup>d</sup>	TLH, LSH	150 <sup>d</sup>	70 <sup>d</sup>	527 (51.9%)	NA	3 (0.6%) within 48 h; 19 (3.6%) in 3 mo; 21 (4.0%) in 12 mo <sup>b</sup>
Lieng et al. <sup>19</sup>	Norway	Prospective	43	43 B	44	BMI 24 <sup>d</sup>	LSH	55 <sup>d</sup>	NA	39 (90.7%)	5.8 h <sup>d</sup>	NA
Ming et al. <sup>24</sup>	Spain	Prospective	88	68 B, 20 M	50.6	BMI 26.0 <sup>d</sup>	TLH±BSO	78 <sup>d</sup>	114 <sup>d</sup>	24 (27.3%)	22.7 h <sup>d</sup>	3 (3.4%) (time interval not specified)
Donnez et al. <sup>25</sup>	Belgium	Prospective	105	105 B	45.8 <sup>b</sup>	BMI 25.6 <sup>c</sup>	TLH	44 <sup>bc</sup>	NA	105 (100.0%)	4.9 h <sup>c</sup>	0
Maheux-Lacroix et al. <sup>26</sup>	Canada	Prospective	151	151 B	45 <sup>b</sup>	Weight 68 kg <sup>c</sup>	TLH	131 <sup>bc</sup>	56 <sup>bc</sup>	128 (84.8%)	NA	1 (0.8%) within 72 h; 6 (4.7%) within 3 mo <sup>b</sup>
Dinesen et al. <sup>27</sup>	Denmark	Prospective	22	20 B, 2 M	53	BMI 25 <sup>d</sup>	RALH	82 <sup>bd</sup>	30 <sup>bd</sup>	22 (100.0%)	225 min <sup>d</sup>	0
Lassen et al. <sup>28</sup>	Denmark	Prospective	26	26 B	45	BMI 26 <sup>d</sup>	TLH	40 <sup>d</sup>	50 <sup>d</sup>	23 (88.5%)	NA	3 (11.5%) within 30 d
Reitenaier et al. <sup>29</sup>	USA	Retrospective	28	28 M	61	BMI 30.3 <sup>c</sup>	TLH, BSO, bilateral pelvic lymphadenectomy	148 h <sup>c</sup>	76 <sup>c</sup>	21 (75.0%)	6.35 h <sup>c</sup>	0
Lee et al. <sup>30</sup>	USA	Retrospective	200	105 B, 95 M	52	BMI 26.8 <sup>d</sup>	RALH	130 <sup>bd</sup>	50 <sup>d</sup>	157 (78.5%)	4.8 h <sup>bd</sup>	4 (2.5%) within 30 d <sup>b</sup>
Alperin et al. <sup>31</sup>	USA	Retrospective	431	431 B	46.5	BMI 30.7 <sup>c</sup>	TLH/LSH	166.2 <sup>c</sup>	80 <sup>d</sup>	400 (92.8%)	0 d <sup>d</sup>	5 (1.2%) (one readmitted within the first 24 h other time intervals not specified)
Melamed et al. <sup>32</sup>	USA	Retrospective	696	103 <sup>a</sup> , 593 M	61.3–61.5 <sup>b</sup>	BMI 31.1–32.5 <sup>d</sup>	TLH, RALH pelvic lymphadenectomy omentectomy	136–144 <sup>bd</sup>	50 <sup>bd</sup>	295 (42.4%)	266 min <sup>bd</sup>	32 (10.8%) within 30 d <sup>b</sup>
Jennings et al. <sup>33</sup>	USA	Retrospective	8890	8157 B, 733 M	46.4 <sup>b</sup>	BMI 30 <sup>c</sup>	TLH, LAVH, LSH±BSO	NA	NA	1855 (20.9%)	NA	277 (3.1%) within 30 d

Abbreviations: B, benign surgical indication; M, malignant surgical indication; BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters; EBL, estimated blood loss; TLH, total laparoscopic hysterectomy; LAVH, laparoscopically assisted vaginal hysterectomy; LSH, laparoscopic supra cervical hysterectomy; BSO, bilateral salpingo-oophorectomy; RALH, robotic-assisted laparoscopic hysterectomy; NA, not available.

<sup>a</sup>Patients with endometrial intra-epithelial neoplasia.

<sup>b</sup>Among patients who were discharged on the same day as surgery only.

<sup>c</sup>Mean value.

<sup>d</sup>Median value.



of titles and abstracts, 2727 were excluded for not meeting the selection criteria. A further 39 studies were excluded owing to full study texts being unavailable and 277 full-text articles were excluded after being reviewed for meeting the exclusion criteria. There were 15 articles<sup>8,10,14,16,19,24–33</sup> included in the systematic review. It was not possible to perform stratified analyses between any minimally invasive surgical procedures and no randomized controlled trials were identified so no meta-analyses were performed. All fifteen studies selected for the review were observational studies (Table 1).

Of the six prospective studies retrieved,<sup>19,24–28</sup> four examined total laparoscopic hysterectomy, one included robotic-assisted laparoscopic hysterectomy, and one included laparoscopic supra-cervical hysterectomy. Among the nine retrospective studies,<sup>8,10,14,16,29–33</sup> five included two or three procedures: total laparoscopic hysterectomy and robotic-assisted laparoscopic hysterectomy (two studies), total laparoscopic hysterectomy and laparoscopic supra-cervical hysterectomy (two studies), and total laparoscopic hysterectomy, laparoscopically assisted vaginal hysterectomy, and laparoscopic supra-cervical hysterectomy (one study); three studies included robotic-assisted laparoscopic hysterectomy only; and one study included total laparoscopic hysterectomy only (Table 1).

All the studies included were published between 2005 and 2015 and comprised a total of 11 992 patients. The studies included small ( $n=16–43$  patients),<sup>10,19,27–29</sup> medium ( $n=88–696$  patients),<sup>8,14,24–26,30–32</sup> and large-scale studies ( $n=1015–8890$  patients).<sup>16,33</sup> There were nine studies conducted in the USA,<sup>8,10,14,16,29–33</sup> one in Canada,<sup>26</sup> and five in Europe.<sup>19,24,25,27,28</sup> There were six studies<sup>14,24,27,30,32,33</sup> that included patients with both malignant and benign indications for hysterectomy and there were 1707 (14.2%) patients included in the review that had malignant indications for surgery.

In six studies,<sup>19,24–28</sup> it was prospectively planned that patients would undergo same-day discharge whereas there were nine studies<sup>8,10,14,16,29–33</sup> where patients were retrospectively categorized as having undergone same-day discharge or having been hospitalized, depending on the length of stay recorded on patient charts. Several studies that were retrieved in the initial search were excluded owing to same-day discharge being defined as discharge within 24 hours of surgery; this definition made it impossible to differentiate between patients who were discharged either before or after midnight.<sup>34–37</sup>

In determining the risk of bias, two authors (M.K. and M.M.J.) completed the relevant checklist (Fig. 2), with an agreement of 95.2%. Attempts to minimize the risk of bias and to account for potential confounding variables were deemed acceptable within the included studies. Despite a severe risk of bias in the included observational studies, primarily arising from retrospective study design and differing outcomes of same-day discharge, most of the studies reported clear associations between the intervention (minimally invasive surgery) and the outcome (same-day discharge).

Overall, 3818 (31.8%) of the patients were discharged before midnight on the day of surgery. When including only the 435 patients from studies that prospectively planned for same-day discharge, 341 (78.4%) patients were discharged before midnight on the day of surgery. Among the 11 557 patients from retrospective studies, and categorized as having undergone same-day discharge or hospitalization,

3477 (30.1%) patients underwent same-day discharge. Re-admission was analyzed from 24 hours to 12 months after discharge; however, some studies did not specify re-admissions times. Among 2218 patients included in the six studies<sup>10,14,16,26,30,32</sup> that included discharge before midnight as a clear definition of same-day discharge, 66 (5.5%) of 1211 patients who were discharged on the day of surgery were re-admitted within 12 months, compared with a readmission rate of 305 of 9774 (3.1%) patients from studies with no clearly defined cut-off time for same-day discharge.

Of the studies with a prospective design, four<sup>19,25,26,28</sup> included only patients with benign surgical indications; of the 325 patients in these studies, 295 (90.8%) were discharged on the day of surgery, compared with 46 of the 110 (41.8%) patients who were included in studies that enrolled patients with both malignant and benign surgical indications.<sup>24,27</sup> Of the nine retrospective studies, two<sup>8,29</sup> included only patients with malignant diagnoses; among these 169 patients, 139 (82.2%) were discharged on the day of surgery.

Pre-operative inclusion criteria from prospective studies included a social network with at least one family or friend to provide care following discharge, American Society of Anesthesiologists (ASA) score of 1 or 2, age younger than 60 years, and adequate motivation and understanding to consent and participate.<sup>19,24–28</sup> Specific exclusion criteria among the prospective studies included patients with ASA scores of at least 3,<sup>19,26,27</sup> patients aged older than 70–80 years,<sup>24,26,27</sup> mental health disability, and mobility limitations (Table 2).<sup>24,26</sup>

There were five retrospective studies<sup>8,10,14,30,32</sup> that reported factors associated with significantly decreased odds of same-day discharge (Table 3); older age,<sup>14,32</sup> comorbidities,<sup>14,32</sup> and higher body mass index<sup>32</sup> were associated with decreased odds of same-day discharge. Factors identified as being associated with hospitalization rather than same-day discharge included beginning operations after 1:00–2:00 PM and completing operations after 6:00 PM.<sup>8,30,32</sup> Additionally, longer operating times were associated with increased risk of hospitalization.<sup>10,14,30,32</sup> A retrospective study<sup>14</sup> reported that the risk of patients requiring hospitalization increased for every 30-minute increase in surgery duration. Higher estimated blood loss during surgery was also found to be associated with increased risk of hospitalization.<sup>8,30</sup> Finally, performing pelvic lymph-node dissection in addition to hysterectomy decreased the odds of discharging patients on the day of surgery.<sup>32</sup>

Post-operative factors that were associated with same-day discharge were only reported in a single study;<sup>8</sup> this study reported an increased pain score among patients who were hospitalized compared with patients discharged on the day of surgery. Patients being discharged on the day of surgery demonstrated a reduced time before resuming oral intake and being able to void following Foley catheter removal<sup>8</sup> (Table 3).

## 4 | DISCUSSION

The available observational studies that examined same-day discharge after minimally invasive hysterectomy suggested that same-day

**TABLE 2** Pre-operative inclusion criteria among prospective studies (n=6).

Study	Inclusion criteria	Exclusion criteria	Conclusions
Donnez et al. <sup>25</sup>	Excessive bleeding due to uterine fibroids  Uterine size equivalent to <14 wk of pregnancy  Uterine adenomyosis unresponsive to medical therapy  Diagnosis of endometriosis, recurrence of cervical dysplasia after more than two conizations, or recurrence of endometrial hyperplasia	Previously undergone surgery for type 3 deep nodular endometriosis or pelvic abscesses, frozen pelvis.  Uterine volume equivalent to >14 wk of pregnancy  Endometrial/cervical cancer at biopsy or suspect adnexal masses  Vaginal bleeding of unknown origin	Outpatient TLH was feasible and safe, and associated with low levels of pain
Minig et al. <sup>24</sup>	At least one family or friend available to provide care following discharge	Surgery converted to laparotomy  Age >70 y  Limited independent mobility at pre-operative assessment  Any kind of mental health disability that could limit autonomy	Peri-operative multimodal recovery program was safe and feasible in a selected group of women following elective laparoscopic hysterectomy.  Patient and physician information is important for successful same-day discharge
Maheux-Lacroix et al. <sup>26</sup>	All patients undergoing TLH  Adequate motivation and understanding  Age <60 y  ASA score 1 or 2, with no sleep apnea  Presumed benign disease  No anticipated surgical complications  Convalescence at a location less than 1 h from the hospital  Continuous home support for 2 d after surgery	Subtotal and laparoscopically assisted vaginal hysterectomies  Malignant disease	Same-day discharge was feasible and safe for carefully selected patients undergoing uncomplicated TLH
Dinesen et al. <sup>27</sup>	All patients scheduled for TLH were candidates for RALH	ASA score $\geq 3$  Age >80 y	Discharge 6 h after RALH was feasible and did not increase readmission  Patients must be well-informed and prepared  Follow-up by nurse-led phone calls the day after surgery was considered beneficial to patients' feelings of security and prevent re-admissions or visits to out-patient clinics
Lassen et al. <sup>28</sup>	Good condition of general health  At least one family or friend available to provide care following discharge		Outpatient laparoscopic hysterectomy appeared to be safe and well accepted by selected patients
Lieng et al. <sup>19</sup>	Normal to moderately enlarged uterus  ASA score 1 or 2  Benign indication		Supra-cervical hysterectomy could be performed safely in an outpatient setting, resulting in high patient satisfaction

Abbreviations: TLH, total laparoscopic hysterectomy; ASA, American Society of Anesthesiologists; RALH, robotic-assisted laparoscopic hysterectomy.



**TABLE 3** Positive predictive factors for same-day discharge.

Study	Baseline variables	Intra-operative variables	Post-operative variables
Melamed et al. <sup>32</sup>	Age 59.0 y (same-day discharge) vs 63.2 y (admitted)	Median duration of surgery 125 min (same-day discharge) vs 152 min (admitted)	
	BMI 30.9 (same-day discharge) vs 32.1 (admitted)	Beginning surgery before 1:00 PM was associated with a two-fold increase in same-day discharge	
	Charlson comorbidity index <5	Patients with endometrial cancer undergoing pelvic lymph node dissection were more likely to be admitted after surgery	
Penner et al. <sup>8</sup>		Lower EBL was associated with increased odds of same-day discharge (range 10–400 mL vs 10–950 mL)	Same-day discharge was associated with lower pain score in the post-anesthesia care unit
		Beginning surgery before 2:00 PM was associated with increased odds of same-day discharge	Same-day discharge was associated with a shorter time before resuming oral intake
		Robotic-assisted laparoscopy was associated with same-discharge in comparison with traditional laparoscopic surgery	Same-day discharge was associated with a reduced time before being able to void following Foley catheter removal
Rivard et al. <sup>14</sup>	For every 10-y increase in age a 50% increase in the risk of hospitalization was observed	Intra-operative adverse events were associated with an eight-fold increase in the odds of hospitalization	
	Age >70 y was associated with a three-fold increase in the risk of hospitalization	For every 30-min increase in surgical duration the risk of hospitalization increased	
	Comorbidities and lung disease were associated with decreased odds of same-day discharge		
Borahay et al. <sup>10</sup>		Length of operation 217.43 vs 293.8 min (mean)	
Lee et al. <sup>30</sup>		Lower EBL was associated with increased odds of same-day discharge (range 5–300 mL vs 10–800 mL)	
		Shorter operating time was associated with increased odds of same-day discharge	
		A shorter time from patients entering the operating room to leaving was associated with increased odds of same-day discharge	
		Surgery finishing before 6:00 PM was associated with increased odds of same-day discharge	
		Intraoperative use of ketorolac was associated with increased odds of same-day discharge	

Abbreviation: EBL, estimated blood loss.

discharge was feasible in 31.8% of patients. Among prospectively designed studies, 78.4% of patients were discharged on the same day of surgery, compared with 30.1% of patients in retrospective studies. The difference in results between these studies emphasizes the importance of careful pre-operative planning to increase the possibility of same-day discharge. Further, the findings could indicate

the drawbacks of a retrospective study design; in these studies, the same-day discharge and re-admission rates could have been underestimated owing to missing data regarding the exact time of discharge.

In a retrospective study, Rivard et al.<sup>14</sup> outlined the importance of a well-planned fast-track program, reporting that 20% of patients who required hospitalization did so for social reasons such





as a lack of transportation from the hospital, requiring placement in a rehabilitation facility, or arranging further healthcare services. Home support from family or friends to provide care after discharge was observed in the pre-operative selection criteria among prospective studies with a very high percentage of patients discharged on the day of surgery.<sup>26,28,30</sup> In the study of Melamed et al.,<sup>32</sup> patients were routinely offered same-day discharge; however, very clear and specific inclusion and discharge criteria were included. Therefore, careful pre-operative planning, including clear pre-operative patient-selection criteria, and reassurances regarding family support at home on the first post-operative night, could be very beneficial in attempting same-day discharge following minimally invasive hysterectomy.

In the present review, having a malignant indication for minimally invasive surgery was associated with a decreased possibility of same-day discharge. This could reflect that, in many gynecologic cancer operations, the inclusion of additional procedures such as pelvic- and a para-aortic lymph node dissection prolongs operating times considerably, thereby decreasing the odds of same-day discharge being achieved. During the past decade, increased focus has been placed on the safety of using minimally invasive surgery for complex gynecologic cancer surgeries. Worldwide, several cancer centers have undergone a paradigm shift towards increasing the use of minimally invasive surgical techniques, especially robotic-assisted laparoscopy (e.g. for localized endometrial and cervical cancer), and several studies have confirmed their safety in terms of adverse events and oncologic outcomes.<sup>38–42</sup> Consequently, it is likely that future studies will focus on further decreasing the duration of hospital stay for patients undergoing more advanced surgical procedures. In the present study, the findings from patients with malignant diagnoses should be interpreted with caution owing to the small number of patients; the available literature do not preclude patients with cancer from undergoing same-day discharge.<sup>10,26,43</sup> Therefore, it is suggested that patients undergoing minimally invasive surgery for early-stage endometrial, cervical, or ovarian cancer could be considered candidates for same-day discharge, in particular, with sufficient pre-planning and careful patient selection (e.g. prioritizing younger patients without co-morbidities as the first operations performed each day).

Generally, re-admission rates were low in all the studies included. This could simply reflect the scope of the present study—studies focused on same-day discharge that included patients undergoing surgery using techniques associated with a low risk of re-admission. An important issue identified by Melamed et al.<sup>32</sup> was that patients discharged on the day after surgery were more likely to have an emergency-room or care visit compared with patients discharged before midnight; however, no difference in re-admission rates was reported. This study also suggested that younger patients, those with a lower body mass index, and those undergoing simpler procedures were particularly good candidates for same-day discharge.<sup>32</sup> Jennings et al.<sup>33</sup> reported a re-admission rate of 3.1% among 8890 patients. The study identified diabetes, chronic obstructive disease, disseminated cancer, chronic steroid use, daily alcohol use above two drinks,

and bleeding disorders as pre-operative factors associated with an increased risk of requiring re-admission within 30 days.<sup>33</sup> These findings give rise to some important considerations regarding pre-operative patient selection that should be considered when implementing a fast-track surgical program successfully (i.e. with a low re-admission rate), emphasizing the importance of age, low ASA scores, and few comorbidities in patient selection. By considering such criteria, re-admission rates can be kept low and the safety of same-day discharge can be established.

A randomized controlled trial that was not included in the present systematic review<sup>44</sup> concluded that the use of low pneumoperitoneum pressure reduced pain during the first post-operative hours in patients undergoing hysterectomy. The present review identified several pre-operative and peri-operative factors that were associated with increased success in same-day discharge. Low pneumoperitoneum pressure could be added to the peri-operative factors that should be routinely assessed during low-risk procedures performed as part of fast-track programs.

It would have been interesting to compare robotic-assisted laparoscopy and conventional laparoscopy in terms of successful same-day post-surgical discharge. Further, it would have been very interesting to compare outcomes across surgical procedures or differing complexity. Unfortunately, to the best of our knowledge, no randomized controlled trials have compared the two surgical approaches in a large homogenous population with either malignant or benign disease. Several studies have compared each of these approaches with open surgery, reporting equivalent oncology outcomes but significant benefits for minimally invasive surgery in terms of blood loss, hospital stay, and post-operative adverse events.<sup>4,10–13</sup> Consequently, the present review is not able to make valid comparisons between patients who underwent robotic-assisted laparoscopy and those treated with conventional laparoscopy. It is questionable whether such a study will ever be performed but, based on existing data, we believe that in the future the two surgical approaches will be used interchangeable depending on the complexity of the procedure and the preferences and skills of individual surgeons. The increasing use of minimally invasive surgery is likely to change surgeon attitudes toward early patient discharge generally. It is suggested that the present review assists in elucidating the possibility of same-day discharge for a large proportion of patients, independent of the specific laparoscopic technique applied, and that there could be scope to expand the use of same-day discharge in the future.

The main limitation of the present study was the comparatively poor quality of the available literature on outcomes and intervention measures. A Cochrane review from 2015<sup>45</sup> that compared fast-track gynecologic oncology surgery programs with conventional recovery strategies did not identify any randomized controlled trials. Observational studies have potential bias due to both publication and selection bias. A broad search strategy was applied to reduce selection bias but unpublished studies could have been missed. Publication bias can occur through the inclusion of a small number of patients in some studies and the checklist used could have been unable to detect possible risks of bias within studies.

The observational studies reviewed suggested that same-day discharge was feasible for a high percentage of patients following



minimally invasive hysterectomy. Several factors were associated with same-day discharge, including pre-planning same-day discharge and careful patient selection. Same-day discharge would likely reduce healthcare costs.

## AUTHOR CONTRIBUTIONS

MK was responsible for designing and planning the study, designing the search strategy, searching the literature databases, screening article titles and abstracts, discussing full-text articles to decide on the articles included, conducting data analysis, completing the risk-of-bias checklist, and writing and revising the manuscript. OM was responsible for designing and planning the study, designing the search strategy, and writing and revising the manuscript. MMJ was responsible for screening article titles and abstracts, discussing full-text articles to decide on the articles included, conducting data analysis, completing the risk-of-bias checklist, and writing and revising the manuscript. VKL was responsible for discussing full-text articles to decide on the articles included, and writing and revising the manuscript. KT was responsible for planning the study, the selection of the articles, and writing and revising the manuscript. PTJ was responsible for designing and planning the study, designing the search strategy, discussing full-text articles to decide on the articles included, conducting data analysis, and writing and revising the manuscript. All authors have reviewed the final version of the manuscript and approved its submission.

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## CONFLICT OF INTEREST

The authors have no conflicts of interest.

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